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COUNTY OF INYO
WATER DEPARTMENT

February 25, 2003

Memorandum

To: Greg James, Water Department Director

From: Bob Harrington, Hydrologist III

Subject: Hydrological impacts of groundwater pumping for Laws irrigation supply

Introduction

The Los Angeles Department of Water and Power (LADWP) and Inyo County (Inyo) are currently developing a Draft Negative Declaration for a project entitled "Irrigation Project in the Laws Area" (Project). The Project comprises resumption of irrigation in the Laws area, reclassification as non-irrigated of some formerly irrigated lands , changes in the irrigation duty for some irrigated lands, exemption from the on/off provisions of the Inyo/Los Angeles Long-Term Groundwater Management Agreement (LTWA) of wells for irrigation supply and to serve as a back-up supply for the town of Laws, and revegetation of some formerly irrigated land. This memorandum describes the effect on the water table of supplying the Project with water.

The Draft Negative Declaration describes the water supply for the Project as a combination of groundwater and surface water. Areas irrigated by center-pivot sprinklers are proposed to be supplied by wells 365W and 236W, and flood irrigated areas are proposed to be supplied by a combination of surface water from Silver Canyon Creek and the Owens River, and groundwater pumped from wells along the Upper McNally Canal. Wells 365W and 236W would comprise the sole source for the center-pivot sprinklers, and therefore are proposed to be exempted from the on/off provisions of the LTWA. For purposes of a back-up town supply and a supply for sprinkler irrigation of the Laws Historical Museum E/M Projects, well 413W is also proposed to be exempted. Figure 1 shows the locations of the sprinkler and flood irrigation areas of the Project, and the location of wells proposed for exemptions from the on/off provisions of the LTWA. The proportions of surface water and groundwater that will be used to supply the flood irrigation are not specified in the Negative Declaration, nor is the frequency or volume of future diversions from the Owens River known; therefore three scenarios were examined to encompass this uncertainty:

Scenario1. This scenario approximates conditions where the exempted wells supply the sprinkler irrigation and surface water from Silver Canyon Creek and the Owens River is used to supply the flood irrigation. Wells 365W and 236W were operated at 2.7 and 1.0 cubic feet per second (cfs) respectively to supply the the sprinkler irrigated part of the Project during the irrigation season. The McNally canals were operated to supply the flood irrigated part of the project.

Scenario 2. This scenario approximates conditions where the exempted wells supply the sprinkler irrigation and no other irrigation occurs. Wells 365W and 236W were operated at 2.7 and 1.0 cubic feet per second (cfs) respectively to supply the the sprinkler irrigated part of the Project during the irrigation season. The McNally canals were assumed to not be operating and the areas designated in the Project for flood irrigation were assumed to be unirrigated in this scenario.

Scenario 3. This scenario approximates conditions where the entire project is supplied by groundwater and Silver Canyon Creek. Wells 365W and 236W were operated at 2.7 and 1.0 cubic feet per second (cfs) respectively to supply the sprinkler irrigated part of the Project during the irrigation season. The McNally canals were assumed to not be operating and the flood irrigated part of the Project was irrigated by operation of wells 245W, 387W, and 388W at rates of 0.4, 2.7, and 5.6 cfs respectively.

Common to all three scenarios is operation of well 413W at a rate of 0.39 cfs during the irrigation season to supply the town of Laws and irrigate the Laws Historical Museum E/M Project (143 acre-feet per year). Although well 413W is only proposed to serve as a back-up water supply for the town, to be conservative, it was assumed that the well would be operated as the primary source of water for the town. Parcel LAW027 is assumed to be sprinkler or drip irrigated with water from Coldwater Creek in all three scenarios.

Methods

The three scenarios were evaluated using a regional groundwater flow model for the Owens Valley developed by the US Geological Survey (Danskin, 1998). This model was developed as part of a cooperative study between LADWP and Inyo during the 1980's. For the present evaluation, it was used to evaluate the amount of drawdown induced by the various wells pumped in each scenario. The initial state of the system in the first scenario was a steady-state wherein the McNally Canals were treated as being in constant operation, providing 5325 acre-feet per year of recharge to the Laws area. In scenarios 2 and 3 the initial steady-state of the system treated the McNally canals as providing no recharge to the Laws area.

The Final Environmental Impact Report for the LTWA (City of Los Angeles and County of Inyo, 1991) reports that well 365W and 236W have capacities of 1.6 and 4.6 cfs respectively. Well 365W has been operated at montly average rates as high as 3.01 cfs in the mid-1980's and as high as 2.67 cfs more recently, so the capacity reported in the FEIR is evidently too low. Under the Project, well 365W would be the primary supply for the sprinkler irrigation and 236 W would augment the primary supply. The Project proposes to irrigate 442 acres with a 3 acre-feet of water per acre by center-pivot sprinklers, or, equivalently, 3.66 cfs throughout a 183 day irrigation season. To provide this flow, each scenario operated wells 365W and 236W for half the year at 2.7 and 1.0 cfs respectively.

The Project proposes to irrigate 514 acres with 5 acre-feet per acre by flood irrigation and 411 acres at 3 acre-feet per acre, or equivalently, 10.52 cfs. Assuming that the entire average (1943-2001) flow rate in Silver Canyon Creek of 1.84 cfs would be available for flood irrigation, an average of 8.68 cfs would be needed from either the Owens River or groundwater wells. In the third scenario, wells 245W, 387W, and 388W were used to supply 8.7 cfs to the flood irrigation areas for half of each year. Pumping to account for conveyance losses is largely offset by the recharge resulting from channel seepage within conveyances, and therefore is neglected.

The fraction of irrigation water that infiltrates to the water table varies widely, depending on soil conditions, application rates, and irrigation methods. For this evaluation, it was assumed that 20% of the irrigation infiltrated back to the water table, which falls within the range for both flood and sprinkler irrigation systems (Tanji and Hanson, 1990, Table 35-1). Actual infiltration rates for flood irrigated areas could be as high as approximately 40%. 20% was used here because the lower rate results in greater drawdown and thus presents a more conservative estimate of the impacts of the Project.

As with any environmental model, this one has several limitations. The model was originally developed to assess regional effects and has a rather large cell size, 2000 ft, for addressing wellfield-scale questions. The large cell size imparts uncertainties of several feet near pumping wells, with the absolute error decreasing as the distance from pumping wells or irrigated areas increases. For example, monitoring site Laws 2 and sprinkler irrigated parcels LAW088 and LAW099 reside in the same model cell, which probably exaggerates the annual cycle of recharge at the monitoring site (Figure 2A). As with any groundwater model, the representation of the aquifer framework and water budget is based on limited data, highly uncertain, and subject to many simplifying assumptions. For example, in scenario 1, the McNally canals are assumed to be in constant operation for six years. While this assumption is not realistic, it is necessary to separate the effects of the pumping from other variables. Additionally, other scenarios exist for supplying the project, for example other wells could have been used for supply in scenario 3. Also, the six years of invariant annual operations that were applied to each scenario were intended to evaluate the long-term effect of a specific water supply source; however, this is a somewhat unrealistic mode of operation. In reality, interannual variations in runoff and lease operations will result in changes in the water supply source from year to year.

Results

Figures 2 through 5 summarize the results of the three scenarios modeled. In all three scenarios, well 413W is operated to supply the town of Laws and to irrigate the Laws Historical Museum E/M Project. Although well 413W is only proposed to serve as a back-up water supply for the town, to be conservative, it was assumed that the well would be operated as the primary source of water for the town. Figure 2 shows the drawdown for each scenario at monitoring site Laws 2 and vegetation parcel LAW030. These two sites are representative of areas of native phreatophytic vegetation that may be impacted by groundwater pumping to supply the project. Figures 3 through 5 are contour maps of drawdown due to each pumping scenario.

Scenario 1 (Wells 365W and 238W pumping to supply sprinkler irrigation; McNally canals running). After six irrigation seasons, this scenario resulted in less than 1 ft of drawdown at monitoring site Laws 2 and between 1 and 2 ft of drawdown in vegetation parcel LAW030 (Figures 2 and 3). Figure 3 shows that drawdown from this scenario was largely in irrigated areas or areas of non-phreatophytic vegetation, but groundwater dependent parcels west of the Project area would undergo drawdown of between 1 and 2 ft.

Scenario 2 (Pumping as per scenario 1; McNally canals not running). After six irrigation seasons, this scenario resulted in drawdown of approximately 1 ft at monitoring site Laws 2 and between 3 and 4 ft in vegetation parcel LAW030 (Figures 2 and 4). Again, drawdown was greatest in areas of irrigation or non-phreatophytic vegetation, however groundwater dependent parcels west of the project area would undergo drawdown of up to 3 to 4 ft (Figure 4).

Scenario 3 (Wells 365W and 236W pumping to supply sprinkler irrigation; wells 245W, 387W, and 388W pumping to supply flood irrigation; McNally canals not running). Scenario 3 posits a greater amount of pumping than either of the other scenarios, which results in greater impact on the water table. After six irrigation seasons, drawdown at monitoring site Laws 2 was between 4 and 6 ft and drawdown in vegetation parcel LAW030 was approximately 15 ft (Figures 2 and 5). These model results are consistent with observations of drawdown during the early 1990's when the Laws wellfield was subject to large volumes of pumping. Like the first two scenarios, the drawdown in areas of phreatophytic vegetation is greatest in the northern part of the wellfield, and though the areas of greatest drawdown are in areas of irrigated or non-phreatophytic vegetation, significant drawdown occurs in groundwater dependent vegetation parcels west of the irrigated areas (Figure 5).

Conclusions

The impact of the Project on the water table cannot be determined with certainty, because the various sources of water identified in the initial study cause different amounts of drawdown depending on which source or combination of sources is used to supply the Project. By themselves, the proposed exemption and operation of wells 236W, 365W, and 413W do not appear to have significant impacts on areas of phreatophytic vegetation; however, coupled with pumping to supply flood irrigated areas of the project, the cumulative impact of supplying the project may be significant.

References

City of Los Angeles and County of Inyo, Water Supply From the Owens Valley to Supply the Second Los Angeles Aqueduct, Final Environmental Impact Report, 1991.

Danskin, W., Evaluation of the Hydrologic System and Selected Water-Management Alternatives in the Owens Valley, California, USGS Water Supply Paper 2370-H, 1998.

Tanji, K.K., and B.R. Hanson, Drainage and Return Flows in Relation to Irrigation Management, in Irrigation of Agricultural Crops, B.A. Stewart and D.R. Nielsen editors, Agronomy No. 30, ASA, CSSA, SSSA, 1990.

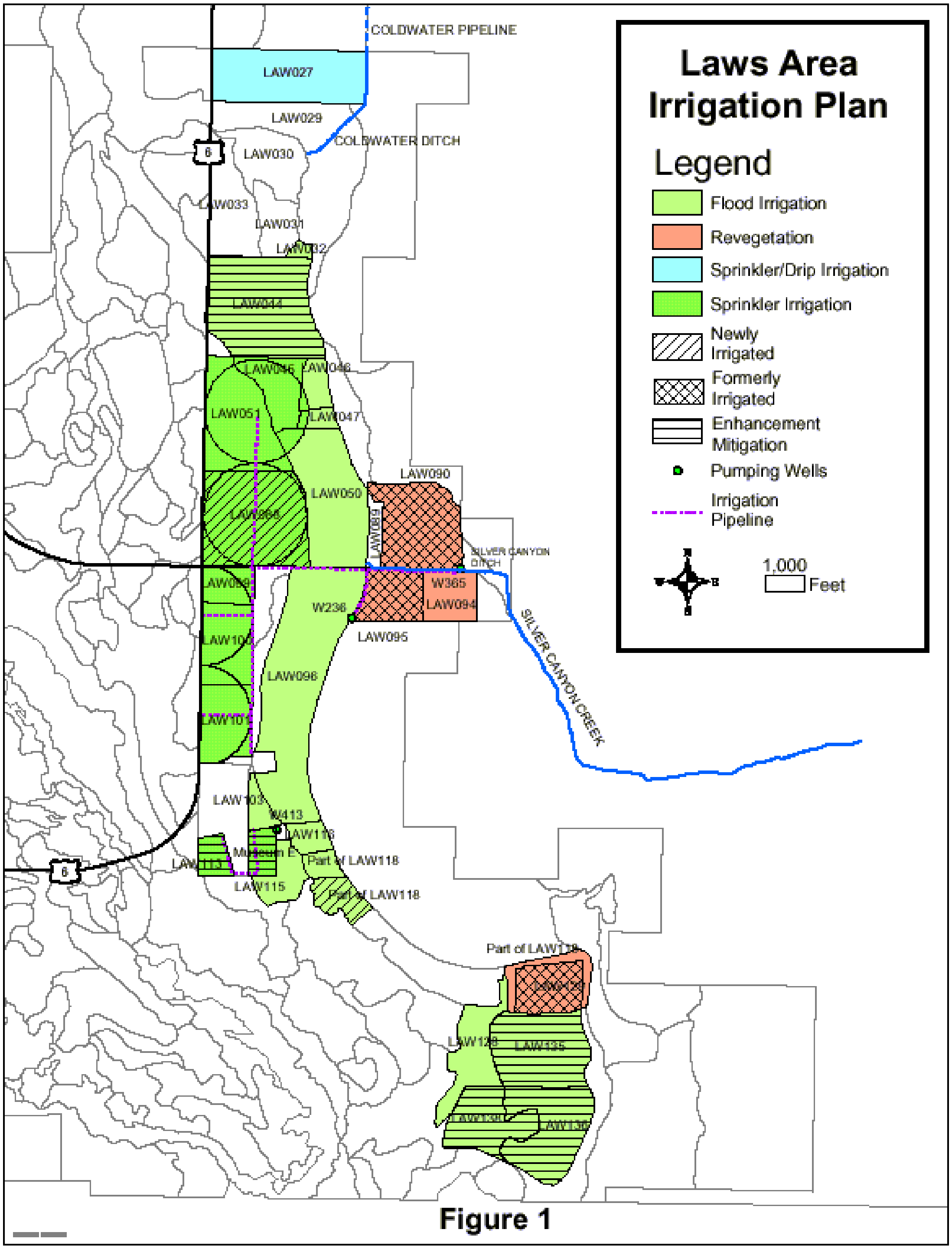

Figure 1. Project map.

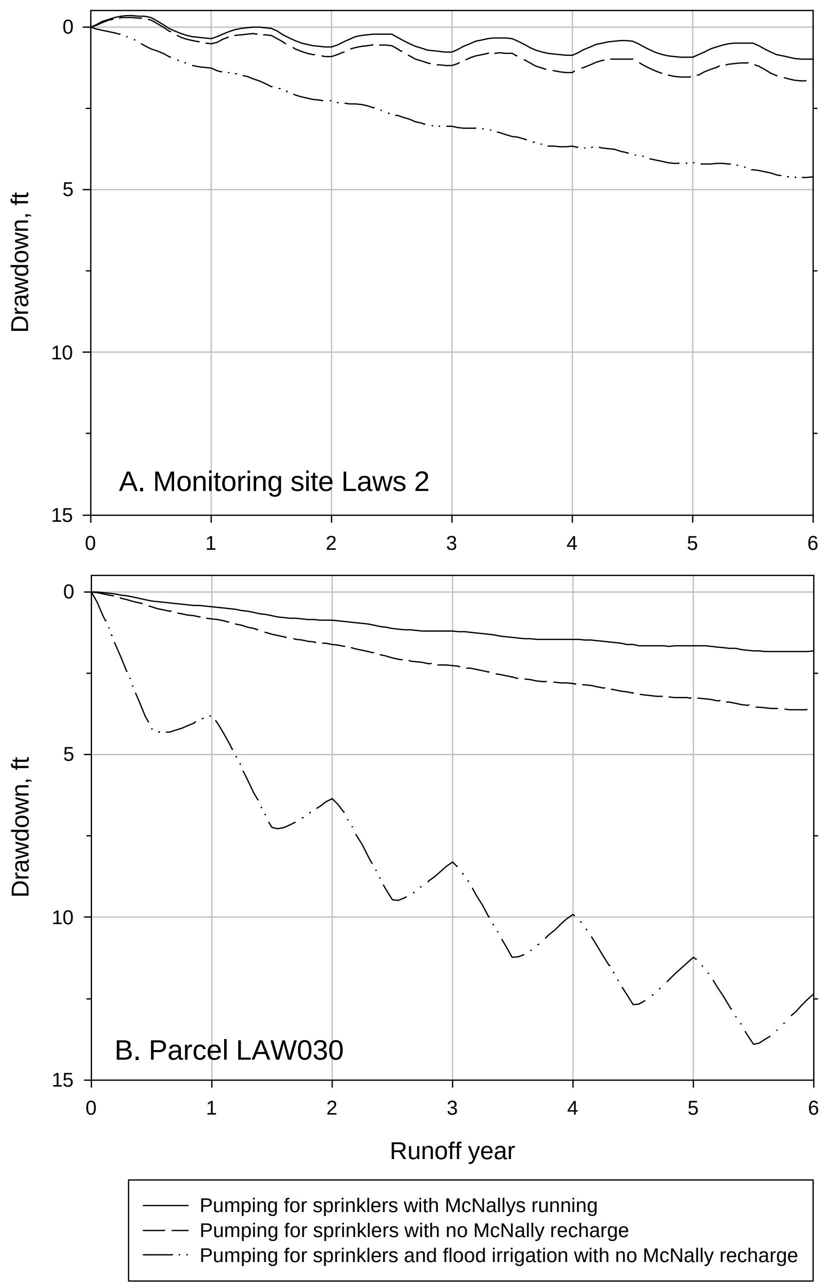

Figure 2. Drawdown resulting from each pumping scenario at (A) monitoring site Laws 2 and (B) vegetation parcel LAW030.

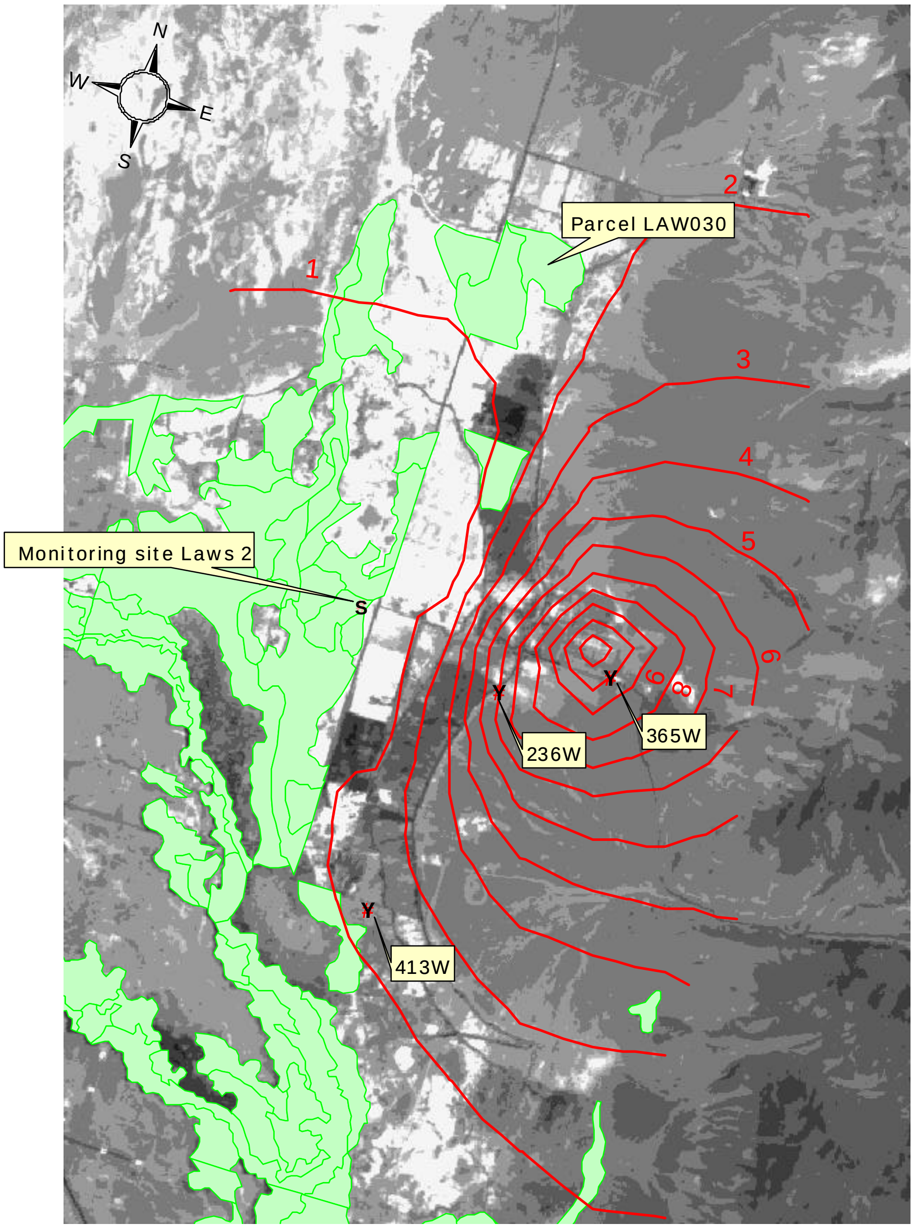

Figure 3. Drawdown contours (ft) after six irrigation seasons resulting from scenario 1.

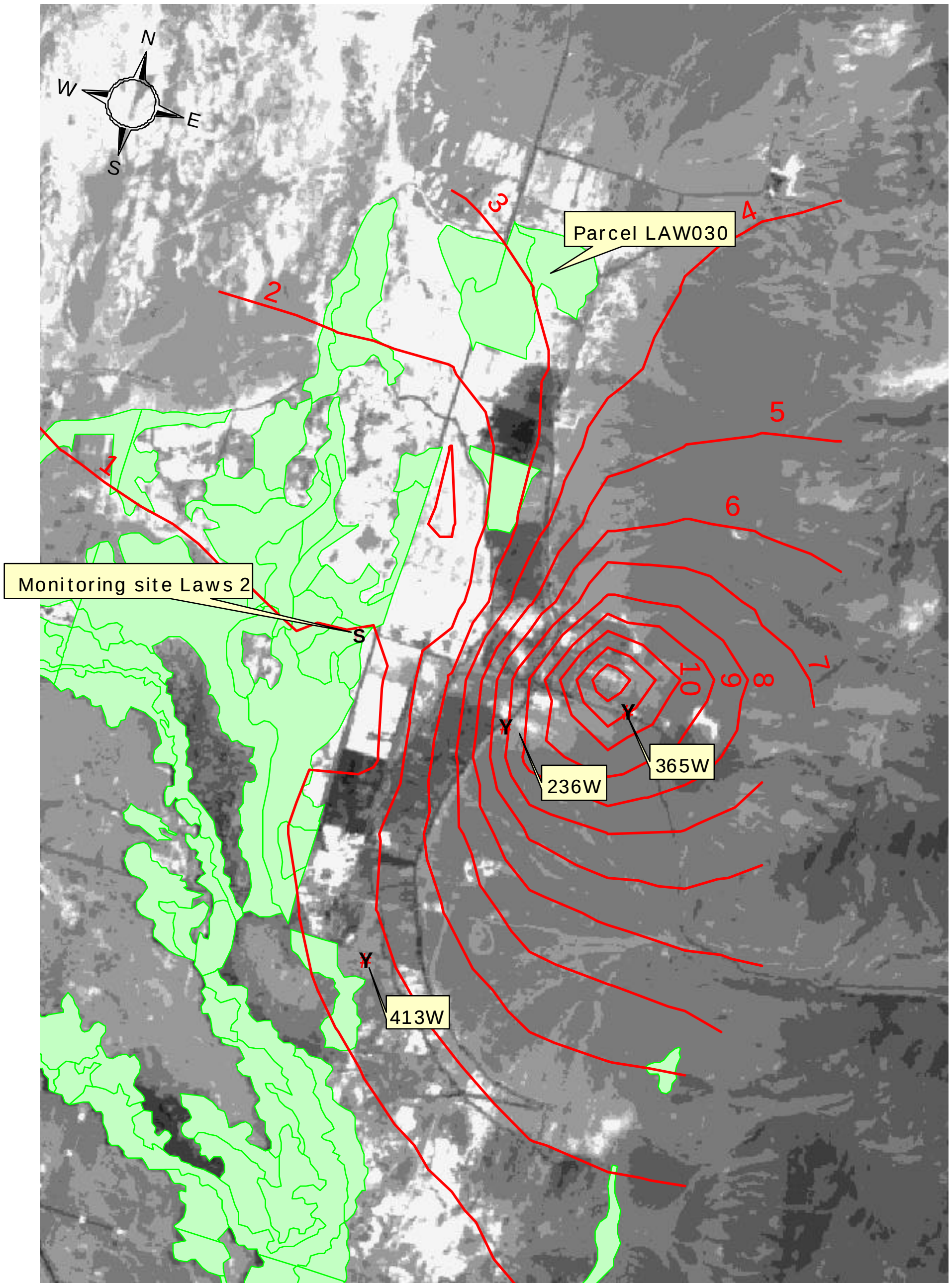

Figure 4. Drawdown contours (ft) after six irrigation seasons resulting from scenario 2.

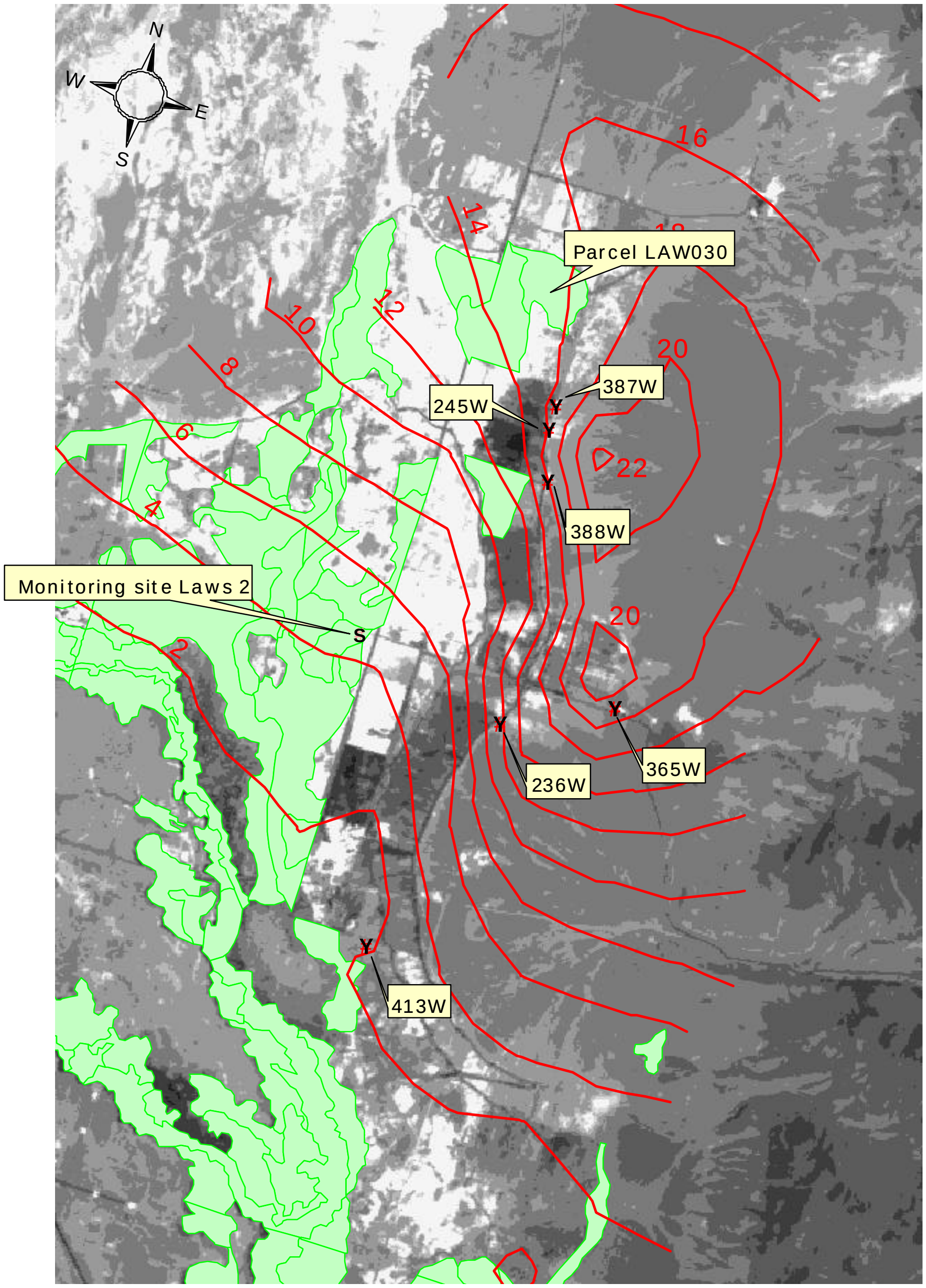

Figure 5. Drawdown contours (ft) after six irrigation seasons resulting from scenario 3.